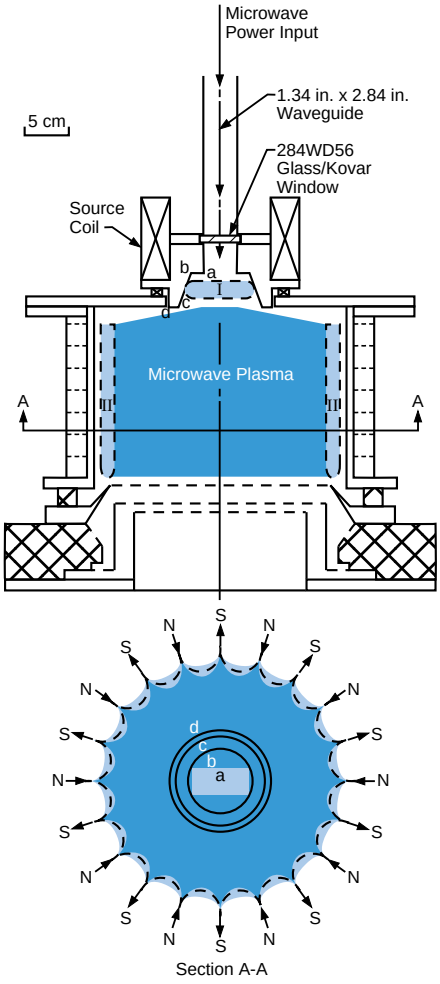
GROWING DIAMONDS, REDUCING WASTE

Plasmas can be produced and sustained by directing electromagnetic energy into a gas. Both microwave and radio-frequency (rf) energy have been used for plasma production and heating in fusion experiments. The high-power systems developed for these purposes have been applied to industrial problems outside fusion.

Insights gained from the interaction of hydrogen plasmas with graphite components in fusion devices have been used to develop rf-based systems for creating diamond and diamond-like carbon films. These films have a number of existing and potential applications in electronics and the automotive industry. Plasma processing techniques with manufacturing applications are being developed. High-power rf and microwave heating systems are also being applied to environmental remediation projects.

The use of plasmas has been extended beyond fusion to many other areas, including diamond coatings, new surface cleaning techniques, and solutions to environmental problems.



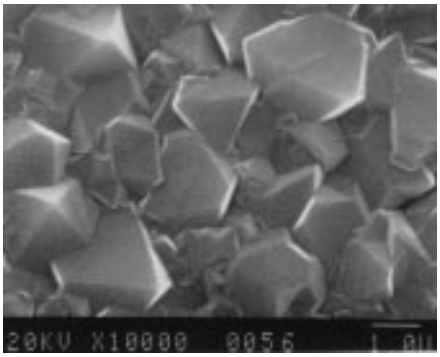
Plasma Generator

When the energetic particles in a fusion plasma strike a solid material, they knock atoms from that material into the plasma. These "impurity" atoms radiate energy away from the plasma and cool it. To minimize this radiation, fusion devices are equipped with graphite structures called limiters and divertors that keep the plasma away from the metal walls of the vacuum vessel.

At Sandia National Laboratories (SNL), fusion researchers studying the interaction of hydrogen plasmas with graphite limiter tiles noted the similarity of carbon-hydrogen films on the tiles to diamond-like carbon (DLC), an amorphous alloy of carbon and hydrogen with properties similar to those of diamonds. They have studied the properties of these films to determine the combination of plasma production techniques and carbon surfaces that yields the best results.

This work has led to the development of DLC coatings with improved adhesion and hardness. Work is under way at SNL on coatings to reduce friction and wear, on improvements in thermal management for electronic packaging, and on innovative diamond-based materials.

At Oak Ridge National Laboratory (ORNL), fusion researchers and other scientists are investigating



diamond film growth as part of a program for fundamental studies of chemical vapor deposition (CVD) materials growth processes. A novel technique for plasma-assisted CVD has been developed, and high-quality diamond films have been produced.

Development of processing techniques, diagnostics, and materials characterization techniques is producing knowledge of molecular dynamics, important process variables, and the relationship of film microstructure to its properties. This information will make it possible to model film growth and optimize film properties.

Using an rf source to produce an oxygen plasma, ORNL researchers have developed a system for removing oil films from the surfaces of manufactured workpieces. This technology, which helps to minimize wastes by removing the need for solvents, has been licensed to SEMATECH.